CLAIMS

1. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a relay telescope having a telescope focal point, which relays an image of an input beam on a beam line;

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell; and

an adjustable attenuator in the beam line between the collimated SBS cell and the focused SBS cell.

2. The system of claim 1, wherein said first SBS cell comprises an SBS medium, and is adapted for a beam that is collimated or nearly collimated within the SBS medium.

3. The system of claim 1, wherein said adjustable attenuator comprises an adjustable beam splitter, by which a portion of the beam is directed out of the beam line.

4. The system of claim 1, wherein said adjustable attenuator comprises a partially reflective plate, disposed at an adjustable angle of incidence in the beam line by which a portion of the beam is directed out of the beam line, and wherein reflectivity of the partially reflective plate is variable by rotating the plate to vary the adjustable angle of incidence.

5. The system of claim 1, wherein an input beam comprising an input pulse is supplied to the relay telescope, and wherein the focused SBS cell has a nonlinear SBS threshold, and adjustment of the adjustable attenuator causes a shift in time within the pulse at which the focused SBS cell reaches the nonlinear SBS threshold, to thereby control pulse width of a reflection of the input pulse.

6. The system of claim 1, wherein the first SBS cell comprises an SBS medium, and the SBS medium comprises a perfluoro compound.

7. The system of claim 1, wherein the first SBS cell comprises an SBS medium in a sealed chamber, and the SBS medium comprises a filtered perfluoro compound having essentially no particulate contaminates greater than about 0.1 microns in size.

8. The system of claim 1, wherein the focused SBS cell comprises an SBS medium in a sealed chamber, and the SBS medium comprises a filtered perfluoro compound having essentially no particulate contaminates greater than about 0.1 microns in size.

9. The system of claim 1, wherein the first SBS cell and the focused SBS cell comprise respective SBS media in respective sealed chambers, and the SBS media comprise a filtered perfluoro compound having essentially no particulate contaminates greater than about 0.1 microns in size.

10. The system of claim 1, including:

a beam splitter between the first SBS cell and the relay telescope, directing a fraction of the beam to an alternate beam path having an alternate path focal point; and

an alignment detector at the alternate path focal point.

11. The system of claim 1, including:

a baffle at the telescope focal point which blocks off angle beams.

12. The system of claim 1, wherein the first and second SBS cells comprise a fluid SBS medium, and including:

a pump and a filter coupled to at least one of the first and second SBS cells, for *in situ* filtration of the fluid SBS medium.

13. The system of claim 1, wherein the first and second SBS cells comprise a fluid SBS medium, and including:

a pump and a filter coupled to at least one of the first and second SBS cells, for *in situ* filtration of the fluid SBS medium, and wherein the filter has a pore size of about 0.1 microns or less.

14. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a relay telescope having a telescope focal point, which relays an image of the beam on a beam line;

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell;

a beam splitter between the first SBS cell and the relay telescope, directing a fraction of the beam to an alternate beam path having an alternate path focal point; and

an alignment detector at the alternate path focal point.

15. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a relay telescope having a telescope focal point, which relays an image of the beam on a beam line;

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell, wherein at least one of the first SBS cell and the focused SBS cell have an SBS medium comprising a compound having a negative non-linear index of refraction with absolute value of less than about 1×10^{-12} esu.

16. The system of claim 15, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound.

17. The system of claim 15, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound, and wherein the filter has a pore size of about 0.1 microns or less.

18. The system of claim 15, wherein said compound comprises a perfluoro compound.

19. The system of claim 15, wherein said compound comprises a perfluoro compound having a non-linear index of refraction of about -4.7×10^{-13} esu, a threshold of about 2.5 mJ at a pulse width of about 18 nanoseconds, and a non-linear gain of about 6.2 GW/cm.

20. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a phase conjugator comprising a first SBS cell and a focused SBS cell in a beam line, having an SBS focal point inside the focused SBS cell;

a relay telescope having a telescope focal point, optically coupled with the phase conjugator, which relays images of an output of the gain medium between an image location on the beam line and an image location near the phase conjugator; and

a baffle at the telescope focal point which blocks off angle beams.

21. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a relay telescope having a telescope focal point, which relays an image of the beam on a beam line;

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell, wherein at least one of the collimated SBS cell and the focused SBS cell have an SBS medium comprising a compound having a negative non-linear index of refraction with absolute value of less than about 1×10^{-12} esu;

an adjustable attenuator between the first SBS cell and the focused SBS cell;

a beam splitter between the first SBS cell and the relay telescope, directing a fraction of the beam to an alternate beam path having an alternate path focal point; and

an alignment detector at the alternate path focal point; and

a baffle having a waist near the telescope focal point which blocks off angle beams.

22. The system of claim 21, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound.

23. The system of claim 21, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound, and wherein the filter has a pore size of about 0.1 microns or less.

24. The system of claim 21, wherein said compound comprises a perfluoro compound.

25. The system of claim 21, wherein said compound comprises a perfluoro compound having a non-linear index of refraction of about -4.7×10^{-13} esu, a threshold of about 2.5 mJ at a pulse width of about 18 nanoseconds, and a non-linear gain of about 6.2 GW/cm.

26. A laser system, comprising:

a gain medium, the gain medium producing pulse energies greater than 2 joules per pulse on a beam line;

a stimulated Brillouin scattering SBS mirror system on the beam line having an input arranged to reflect an incident pulse back through the gain medium, the SBS mirror system including an SBS medium comprising a compound having a negative non-linear index of refraction with absolute value of less than about 1×10^{-12} esu;

a relay telescope having a telescope focal point, between a selected location in the beam line and the SBS mirror system, which relays images of an output of the gain medium between an image location on the beam line and an image location near the input of the SBS mirror system; and

a baffle at the telescope focal point which blocks off angle beams.

27. The system of claim 26, wherein the SBS mirror system comprises:

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell; and

an adjustable attenuator between the collimated SBS cell and the focused SBS cell.

28. The system of claim 26, including:

a beam splitter between the SBS mirror system and the relay telescope, directing a fraction of the beam to an alternate beam path having an alternate path focal point; and

an alignment detector at the alternate path focal point.

29. The system of claim 26, wherein the SBS medium comprises a perfluoro compound.

30. The system of claim 26, wherein said SBS medium comprises a perfluoro compound having non-linear index of refraction of about -4.7×10^{-13} esu, a threshold of about 2.5 mJ at a pulse width of about 18 nanoseconds, and a non-linear gain of about 6.2 GW/cm.

31. The system of claim 26, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound.

32. The system of claim 26, including:

a pump and a filter coupled to said at least one of the first and second SBS cells, for *in situ* filtration of the compound, and wherein the filter has a pore size of about 0.1 microns or less.

33. A method of amplifying a laser pulse comprising:

coupling a seed pulse into a ring shaped optical path including an amplifying medium;

phase reversing the pulse by SBS phase conjugation after one or more transits through the ring in which the pulse traverses the amplifying medium;

coupling an output pulse out of the ring after the pulse traverses the amplifying medium in an equal number of transits through the ring in an opposite direction; and

controlling a pulse width of the output pulse by controlling a threshold of said SBS phase conjugation.

34. The method of claim 33, wherein said phase reversing includes relaying an image of pulse from the amplifying medium to an SBS system, and inducing phase conjugation in said SBS system.

35. The method of claim 33, wherein said phase reversing includes placing an SBS mirror system comprising a collimated SBS cell and a focused SBS cell in the cavity.

36. The method of claim 33, wherein said phase reversing includes placing an SBS mirror system comprising a collimated SBS cell and a focused SBS cell in the cavity; and said controlling the pulse width includes diverting a controlled amount of energy from said pulse out of the cavity between the collimated SBS cell and the focused SBS cell to control said threshold.

37. The method of claim 33, wherein said SBS phase conjugation includes inserting an SBS medium in said cavity, the SBS medium comprising a compound having a negative non-linear index of refraction with absolute value of less than about 1×10^{-12} esu.

38. The method of claim 33, wherein said SBS phase conjugation includes inserting an SBS medium in said cavity, the SBS medium comprises a perfluoro compound.

39. The method of claim 33, wherein said SBS phase conjugation includes inserting an SBS medium in said cavity, the SBS medium comprises a perfluoro compound having a negative non-linear index of refraction of about -4.7×10^{-13} esu, a threshold of about 2.5 mJ at a pulse width of about 18 nanoseconds, and a non-linear gain of about 6.2 GW/cm.

40. The method of claim 33, wherein said SBS phase conjugation includes inserting an SBS medium in said cavity, and including filtering said SBS medium *in situ* to remove particles having a size greater than about 0.1 microns.

41. The method of claim 33, wherein said phase reversing includes placing an SBS mirror system comprising a collimated SBS cell and a focused SBS cell in the cavity; and

aligning the optical cavity using an alignment fiducial between the collimated SBS cell and the focused SBS cell.

42. A stimulated Brillouin scattering SBS phase conjugate mirror system, comprising:

a relay telescope having a telescope focal point, which relays an image of an input beam on a beam line;

a first SBS cell in the beam line adjacent the relay telescope, and a focused SBS cell in the beam line, having an SBS focal point inside the focused SBS cell; and

an adjustable attenuator in the beam line between the collimated SBS cell and the focused SBS cell capable of accepting input pulses greater than 2 juoles per pulse, said

system accepting with input pulse widths of up to about 1 microsecond, and supply reflected pulses with adjustable pulse widths.